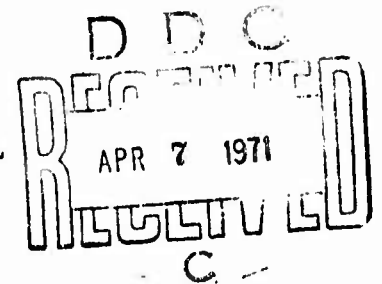


30 December 1968

Materiel Test Procedure 8-4-001
Yuma Proving Ground

U. S. ARMY TEST AND EVALUATION COMMAND
ENVIRONMENTAL TEST PROCEDURE

DESERT ENVIRONMENTAL TEST OF CHEMICAL, BIOLOGICAL
AND RADIOLOGICAL EQUIPMENT



AD721281

1. OBJECTIVE

The objective of this Materiel Test Procedure (MTP) is to provide a procedure for determining the capability of Chemical, Biological and Radiological (CBR) equipment to withstand exposure and to function effectively in desert environments.

2. BACKGROUND

The employment of CBR materiel developed for the Armed Forces, which must be able to perform their mission in any of the earth's environments, is dependent upon the environmental conditions encountered and it is important to test the items in the most extreme natural environment. The desert area contains some of the most extreme conditions found on the earth.

Since environmental testing is a lengthy and expensive process, it is important to run tests in simulated extremes to the maximum extent to be sure it is feasible to be evaluated for use in the desert. Items will not be tested in the desert until their development has reached a particular state of refinement, and data from simulated environmental tests ensure that the items will function satisfactorily in the desert prior to the natural environmental test.

3. REQUIRED EQUIPMENT

a. Temperature measuring instruments as follows:

- 1) Thermometers (0-200° range, $\pm 2^\circ\text{F}$)
- 2) Thermocouples (copper-constantine types 30°-180°F range, $\pm 2^\circ\text{F}$) with readout meters and recorders.

b. Shock measuring instruments, including triaxial accelerometers (0-20g range, $\pm 0.2\text{g}$) with readout meters and recorders.

c. Vehicular instrumentation as follows:

- 1) Odometers (0.1 mile preciseness, ± 0.2 miles)
- 2) Speedometers (0-70 mph range, ± 5 mph)
- 3) Timers (0.01 hour preciseness, ± 0.05 hour)

d. Sensor and counter to measure vehicular traffic levels

e. Standard meteorological instrumentation

f. Instrumentation for determining sunlight intensity (0-12,000-foot candle)

g. Facilities to protect personnel to include individual protective equipment, and fixed or mobile installations to provide CB agent-

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free air to a number of individuals.

- h. Decontamination facilities (individual and large areas)
- i. Animal handling facilities (if required)
- j. Desert paved and secondary roads as described in Reference 4P.
- k. Desert areas as described in Reference 4O.

4. REFERENCES

- A. AR 70-10 Research and Development: Army Materiel Testing, 18 December 1962.
- B. AR 705-15, Research and Development of Materiel: Operation of Materiel under Extreme Conditions of Environment, 14 October 1963.
- C. FM 5-20, Camouflage, Basic Principles and Field Camouflage
- D. FM 31-25, Desert Operations, 28 January 1968
- E. TM 3-220, Chemical, Biological, and Radiological (CBR) Decontamination, July 1964, w/change, 1 December 1965
- F. TM 3-250, Storage, Shipment, and Handling of Chemical Agents and Hazardous Chemicals
- G. MTP 4-4-001, Desert Environmental Test of Ammunition and Explosives
- H. MTP 7-1-002, Air Portability and Airdrop Service Testing
- I. MTP 7-2-509, Air Drop Capability of Materiel
- J. MTP 8-2-500, Receipt Inspection
- K. MTP 8-2-503, Rough Handling and Surface Transport
- L. MTP 8-2-509, Radiography
- M. MTP 8-2-510, Decontamination
- N. MTP 8-2-512, Leak Testing of Agent-Filled Munitions and Containers
- O. MTP 10-4-001, Desert Environmental Testing of General Supplies and Equipment
- P. Test Capabilities at Yuma Proving Ground, 2nd Edition
- Q. MTP 4-2-800, Physical Measurement of Projectiles
- R. MTP 10-3-500, Pre-Operational Inspection and Physical Characteristics
- S. MTP 7-3-075, Airdrop Items for Equipment and Supply
- T. MTP 7-3-076, Airdrop Items for Personnel
- U. MTP 8-3-506, Safety Hazards

5. SCOPE

5.1 SUMMARY

This MTP describes in general terms; the preparation, conduct, recording, and reporting methods used for desert environmental testing of chemical, biological and radiological equipment. This includes auxiliary equipment (cf. filling apparatus dispensing pumps, field impregnation kits for clothing), collective protective systems (cf. for vans, field shelters, fixed installations), decontaminating equipment (individual kit M13, portable or power driven apparatus), detection and surveillance equipment (cf. chemical and biological detection kits, chemical and biological alarms), dissemination devices (cf. generator/dispenser device, chemical and biological, spray tanks for aircraft, smoke generator), munitions (cf. bomblets, grenades, chemical mines, guided missiles) and individual protective equipment (self-contained breathing apparatus, protective mask, and clothing).

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Specific subtests include:

a. Exposure - The objective of this subtest is to determine the effects of desert environmental exposure to chemical, biological and radiological equipment while in various utilization modes such as storage, transportation and handling.

b. Performance - The objective of this subtest is to determine the capability of chemical, biological and radiological equipment to perform in a desert environment; to ascertain the influence of the desert environment on test item effectiveness; and to determine the effects of exposure to a desert climatic and geophysical environment.

c. Security from Detection - The objective of this subtest is to determine the capability of CBR equipment to avoid detection when stored or operated in desert terrain.

d. Maintenance - The objective of this subtest is to determine the maintenance requirements for chemical, biological and radiological equipment engendered or aggravated by desert environmental conditions.

e. Safety - The objective of this subtest is to determine if the test item is safe for use in a desert environment.

5.2 LIMITATIONS

The procedures presented in this MTP are limited to field testing. Guidance for testing equipment in simulated environments or other induced hot-dry conditions has been intentionally avoided.

The large variety of CBR equipment to which this MTP is applicable precludes complete and detailed test plans. However, a test plan for desert environmental testing of a specific type of CBR equipment may be developed from this MTP. In such a case, each environmental test planning activity must make its own judgement as to the applicability of each procedure and must determine how best to obtain the required data from each item under test.

6. PROCEDURES

6.1 PREPARATION FOR TEST

6.1.1 General Preparations

a. Select test equipment having an accuracy of at least ten times that of the function to be measured.

b. Verify that test facilities, equipment and accessories are available, operational and properly calibrated. Power sources shall be checked to ensure correct outputs.

c. Assure that all test personnel are familiar with the required technical and operational characteristics of the item under test, such as stipulated in Qualitative Materiel Requirements (QMR), Small Development Requirements (SDR), and Technical Characteristics (TC). Test personnel shall be briefed prior to testing on the purpose of the test and results and parameters to be anticipated.

d. Review all instructional material issued with the test item by the manufacturer, contractor, or government as well as reports of previous similar tests conducted on the same type of test items, and familiarize test personnel with the contents of such documents. These documents shall be kept readily available for reference.

e. Prepare record forms for systematic entry of data, chronology of test, and analysis in final evaluation.

6.1.2 Test Item Preparations

a. Prior to beginning environmental tests of chemical, biological, and radiological equipment, develop and prepare a test sample size plan (See Figures 1 and 2) using the following criteria:

- 1) Each test lot shall consist of a statistically significant number of test items

NOTE: Although test samples may consist of a single test item, their size shall be greater than four (4), whenever possible, to increase the statistical accuracy of the test. Table I indicates the decrease in confidence interval with an increase in sample size.

- 2) Sufficient control items shall be used to isolate and identify areas requiring corrective action. (Corrective action in this context includes redesign of the test item, redesign of packaging or storage configurations for the test item, or reduction of the exposure limits).
- 3) Test samples shall be exposed only where indicated in the Tables. During other periods of the test they shall be stored in isothermic ($70^{\circ}\text{F} \pm 5^{\circ}\text{F}$) conditions, and protected from sunlight or intense artificial light. Relative humidity shall be kept between 15 percent (25 percent for items having painted surfaces) and 60 percent.

b. Prior to initial inspection of the test item, randomly select an identification number, place on the container, and transfer the number to the item when the container is opened. The identification number shall be the same as the number used in the scheduling plan in order to facilitate the control, recovery, and analyzing of data, and shall be legible, permanent, and in a location protected as much as possible from exposure.

c. Prior to handling any chemical, biological, or radiological munitions, perform agent leak tests in accordance with MTP's 8-2-511 and 8-2-512.

NOTE: This shall also include testing before receipt inspection, before starting a specific test, periodically throughout the test, and after completion of the test.

d. If leakage is detected, decontaminate and remove the damaged test item for inspection in accordance with the procedures given in TM 3-220.

FIGURE I. Scheduling Table for 2 to 5 Test Items

Sample No.	Road Transport	Fwd Depot Storage	Field Transport	Supply Point	Tactical Movement		
					Sandy Desert	Gravel Desert	Rock Desert
2 Test Items							
1	X	X	X	X	X	X	X
2			Control				
3 Test Items							
1	X	X	X	X	X	X	X
2	X	X	X	X	Control		
3		Control			X	X	X
4 Test Items							
1	X	X	X	X	X	X	X
2	X	X	X	X	Control		
3		Control			X	X	X
4			Control				
5 Test Items							
1	X	X	X	X	X	Control	
2	X	X	X	X	Control	X	Control
3	X	X	X	X	Control		X
4	X	X	X	X	Control		
5			Control				
6 or more Test Items							

See MTP 4-4-001, Appendix A.

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FIGURE II. Scheduling Table For Thirty Test Items or Samples,
with Exposure to all Environments in Paragraph 6.2.

Sample No.	Road Transport	Fwd Depot Storage	Field Transport		Supply Point	Tactical Movement					
						Sandy Desert		Gravel Desert		Rock Desert	
			w/overpack	wo/overpack	Protected Exposed	Container	Open	Container	Open	Container	Open
1	X	X	X	-	X	X	-	-	-	-	-
2	X	X	X	-	X	-	X	-	-	-	-
3	X	X	X	-	X	-	-	X	-	-	-
4	X	X	X	-	X	-	-	-	X	-	-
5	X	X	X	-	X	-	-	-	-	X	-
6	X	X	X	-	X	-	-	-	-	-	X
7	X	X	X	-	-	X	X	-	-	-	-
8	X	X	X	-	-	X	-	X	-	-	-
9	X	X	X	-	-	X	-	-	X	-	-
10	X	X	X	-	-	X	-	-	X	-	-
11	X	X	X	-	-	X	-	-	-	X	-
12	X	X	X	-	-	X	-	-	-	-	X
13	X	X	-	X	X	-	X	-	-	-	-
14	X	X	-	X	X	-	-	X	-	-	-
15	X	X	-	X	X	-	-	-	X	-	-
16	X	X	-	X	X	-	-	-	X	-	-
17	X	X	-	X	X	-	-	-	-	X	-
18	X	X	-	X	X	-	-	-	-	-	X
19	X	X	-	X	-	X	X	-	-	-	-
20	X	X	-	X	-	X	-	X	-	-	-
21	X	X	-	X	-	X	-	-	-	-	-
22	X	X	-	X	-	X	-	-	X	-	-
23	X	X	-	X	-	X	-	-	-	X	-
24	X	X	-	X	-	X	-	-	-	-	X
25	-	-	-	-	-	-	Y	Y	-	-	-
26	-	-	-	-	-	-	-	-	Y	-	-
27	-	-	-	-	-	-	-	-	-	Y	Y
28	Y	Y	Y	Y	Y	-	-	-	-	-	-
29	Y	Y	Y	Y	-	Y	-	-	-	-	-
30	-	-	-	-	-	-	-	-	-	-	-

TABLE I. Confidence Limits for a Two-Sided Proportion at a
90 Percent Confidence Level (from Crow, E.L. __)

f/n	1	2	3	4	5	6	7	8
0	0	0	0	0	0	0	0	0
	.900	.684	.536	.500	.379	.345	.316	.255
1	.100	.051	.035	.026	.021	.017	.015	.013
	1.00	.949	.804	.680	.621	.542	.500	.418
2	-	.316	.196	.143	.112	.093	.079	.069
		1.00	.965	.857	.753	.667	.684	.582
3	-	-	.464	.320	.247	.201	.170	.147
			1.00	.874	.888	.799	.721	.743
4	-	-	-	.500	.379	.333	.279	.240
				1.00	.979	.907	.830	.760
5	-	-	-	-	.621	.458	.316	.255
					1.00	.983	.921	.853
6	-	-	-	-	-	.655	.500	.418
						1.00	.985	.931
7	-	-	-	-	-	-	.684	.582
							1.00	.987
8	-	-	-	-	-	-	-	.745
								1.00

n = number of samples

f = number of observed failures

References: Crow, E.L., F.A. Davis and N.W. Maxfield: Statistics Manual,
NAVORD Report 3369, NOTS 948, U.S. Naval Weapons Test Center,
China Lake, California, 1955.

q. Record the following information:

- 1) Results of initial leak testing performed as part of the receipt inspection.
- 2) Results of leak testing subsequently performed before, during, and after environmental testing.
- 3) Photographs, wherever possible, of items and parts which leaked (i.e., obvious cracks, separations, etc.)
- 4) Narrative comments on procedures followed and reasons (if known) leakage occurred.

f. Check intermediate, unit, packages, and/or unpacked items for evidence of crushing, cracking, breaking, leaking, spilling, corrosion, or contamination with foreign material or agent.

g. Visually inspect the test item for damages such as dents, cracks, holes, broken lens, tears, illegible markings, bent fins, etc.

h. Record serial number and/or lot number.

i. Check for components missing or incorrectly assembled.

j. Determine the presence of internal damage to test item using radiography as described in the applicable section of MTP 8-2-509, when appropriate.

NOTE: Before radiography of munitions containing live pathogens, it must first be ascertained whether or not the radiation exposure will kill the organisms.

k. Correct as many deficiencies as possible. If a critical defect cannot be remedied, remove the item from the test. Clean test item (lubricate or add preservatives if specified in maintenance instructions). Items removed from the test lot should be held for disposal in accordance with the directions of the responsible agency or directorate.

l. Repack items in accordance with planned exposure modes. Do not repack items which will be instrumented for exposure tests at this point.

m. Record the following, and support with photographs where applicable:

1) Shipping container

- a) Physical damage in accordance with MTP 10-3-500
- b) Any evidence of leaking, spilling, corrosion, or contamination.
- c) Adequacy and legibility of markings
- d) Presence and adequacy of unpacking instructions
- e) Presence of packing list
- f) Type and condition of blocking, bracing, and cushioning
- g) Type and condition of intermediate and unit packaging

2) Test Item

- a) Nomenclature, serial number(s), and/or lot number(s) of damaged item(s).

- b) Type and apparent extent of damage
- c) Markings used for future identification
- d) Actions taken on damaged test item, such as type and amount of repairs, removal, or destruction of test item.

n. Determine and record the following physical characteristics of the test item, as applicable:

- 1) Exterior dimensions, width, length, height, etc, on both the test item and major components
- 2) Interior dimensions such as volume of containers or munitions, etc
- 3) Weight of test item and major components
- 4) The radial and longitudinal center-of-gravity
- 5) The moments-of-inertia
- 6) Any other physical measurements which may assist in determining if the test item meets the physical requirements of the QMR, SDR, TS, or other materiel requirements documentation.

6.2 TEST CONDUCT

6.2.1 Exposure

6.2.1.1 Storage Exposure

a. Emplace the test item in the test site in a manner corresponding to storage of the item in a Forward Depot Supply Area.

b. Attach thermocouples to the test item as required to obtain the following temperatures:

- 1) Overpack skin temperature
- 2) Container skin temperature
- 3) Container interior air temperature
- 4) Maximum test item skin temperature
- 5) Average test item skin temperature
- 6) Temperature of critical components
- 7) Explosive, or toxic component temperatures
- 8) Any other temperatures required by the test director

c. Ensure the proper calibration and functioning of all temperature measuring devices attached to the test item.

d. Select the most appropriate exposure type for the particular item to be tested, from Table II., and subject the emplaced test item to a condition of 3780° (Fahrenheit) - hours above 90° F. Typical combinations which will meet this criteria are shown in Table III.

NOTES: 1. Method of storage will be as described in applicable field manuals. All normal procedures will be followed such as adequate dunnage, deparated stacks, with overpacks and pallets (where applicable), and adequate shelter with provision for natural ventilation.

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2. A minimum of 120 vehicles will pass upwind of the storage area during the storage period. Dust deposits of at least 6 inches deep will be maintained on adjoining roads.
3. Test items shall be stored in an exposed area where temperatures, light intensity, and levels of vehicular traffic can be measured. Photographs shall be taken as necessary to show storage conditions.
4. The determination of natural light intensity shall be made by placing sensors parallel to the surface and isolated from marking or reflecting surfaces.
5. Vehicular traffic levels shall be determined by a counter system.

e. Record the following data during exposure of the test item, at hourly intervals:

- 1) Ambient air temperature (200 cm above surface, $\pm 2^{\circ}\text{F}$)
- 2) Ground temperature (5 cm below surface, $\pm 2^{\circ}\text{F}$)
- 3) Thermocouple readings (see Step b.)
- 4) Relative humidity (± 5 percent)

f. Record the following data continuously during exposure of the test item:

- 1) Precipitation (± 0.01 inch)
- 2) Wind speed (200 cm above surface, ± 5 mph)
- 3) Wind direction ($\pm 10^{\circ}$)
- 4) Solar radiation (± 10 BTU/ft²/hr)

g. After each exposure, inspect the test item as prescribed by appropriate documentation, and record all deficiencies and discrepancies discovered.

h. Emplace the test item in the test site in a manner corresponding to storage of the item in a Forward Supply Point.

i. Repeat Steps (b) and (c), above.

j. Select the most appropriate exposure type for the particular item to be tested from Table II., and subject the emplaced test item to the exposure conditions listed in Table IV.

- NOTES:
1. Storage site for the Forward Area Supply Point shall be as realistic as possible (see FM 31-25)
 2. Test items shall be stored in a "ready for issue" mode; if items are issued in containers, they will be left in containers. Adequate drainage, ventilation, and cover shall be provided.
 3. A minimum of 4 vehicles per storage day shall be routed upwind of the storage area. Dust deposits of at least 6 inches in thickness shall be maintained on adjoining roads.

TABLE II. Exposure Requirements (subject to minimum conditions specified in subtests)

Supply Class * and Type	Road Trans (mi)	Fwd Depot Storage (days)	Field Trans (mi)	Fwd Supply Point (days)	Tactical Movement		
					(mi)	(max)	
					Sandy Desert	Gravelly Desert	Rocky Desert
Class II							
Individual Unit	150 paved plus 450 Secondary	60	35	14	70	130	75
		90	35	30	35	70	40
Class IV							
Materials Special		120	35	60	35	70	40
		120	35	30	70	130	75
Class V					Covered in MTP 4-4-001		

* See Appendix A, Classification of Chemical, Biological and Radiological Equipment.

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TABLE III. Exposure Criteria for Forward Depot Storage
(Para. 6.2.1.1) (Based on MIL-STD-210 requirements
adjusted to probable extremes at Yuma, Arizona with a
design goal of 3780° F-hr above 90° F)

Air Temperature (°F)			Ground Temperature (°F)		
No. of Days*	No. of Hr/day	Min Temp	No. of Days*	No. of Hr/day	Min Temp
5	2	110	5	3	140
+10	4	105	+10	4	135
+19	3	100			
3	1	110	5	1	140
+15	4	105	+20	4	135
+13	3	100			
10	4	105	10	1	135
+30	3	100	+30	4	130

* Based on 60 days (Table II). For 30 days, multiply by 0.5; for 90 days by 1.5; and for 120 days by 2.0.

TABLE IV. Exposure Requirements for Forward Supply Point Subtest.

Minimum number of days of storage to include days with temperature in excess of:

<u>Class and Type of Material</u>	<u>Total (see Table II)</u>	<u>Air Temperature</u>		<u>Ground Temperature</u>
		<u>105°F for 4 hr</u>	<u>110°F for 2 hr</u>	<u>135°F for 4 hr</u>
Class II				
Individual	14	10	4	10
Unit	30	26	10	20
Class IV				
Materials	60	50	10	40
Spec Equipment	30	24	8	
Class V	See MTP 4-4-001, Paragraphs 6.2.3.1.2 and 6.2.3.1.3			

k. Repeat Steps (e), (f), and (g), above.

6.2.1.2 Transportation Exposure

6.2.1.2.1 Road Transportation

a. Load the item under test onto a suitable wheeled vehicle. Test items shall be packaged according to normal practice for the commodity involved.

b. Instrument at least one test item to obtain the following information (where applicable):

- 1) Container interior air temperature
- 2) Test item surface temperature
- 3) Explosive and agent temperatures
- 4) Critical components temperatures
- 5) Triaxial acceleration of test items
- 6) Triaxial acceleration of critical components

c. Ensure the proper calibration and functioning of all instrumentation.

d. Expose the test items to desert conditions while transporting them for 150 miles on paved roads or test courses and for 450 miles on secondary roads or a course similar to the YPG Truck Gravel Course.

e. Record the following data continuously during the road transportation phase:

- 1) Ambient air temperature (200 cm above surface, $\pm 2^{\circ}\text{F}$)
- 2) Thermocouple readings ($\pm 2^{\circ}\text{F}$)
- 3) Vehicle bed temperature ($\pm 2^{\circ}\text{F}$)
- 4) Vehicle Direction ($\pm 10^{\circ}$)
- 5) Accelerometer readings ($\pm 1.0^{\circ}$)
- 6) Course description (nomenclature plus topographic details from maps or surveys)
- 7) Time (± 1.0 minute)
- 8) Vehicle speed (± 2 mph)

f. After the transport test, inspect test items for damage and performance of individual items. Test items that are damaged to a point where it will be unsafe to handle or cause test items to fail during performance test, shall be removed from testing and examined.

6.2.1.2.2 Field Transportation

a. Load the item under test on to a suitable wheeled cargo carrier. Test items shall be packaged according to their normal packaging modes; if use of overpacks is optional at this point, half of each sample shall be transported in this mode.

- b. Repeat steps (b) and (c) of 6.2.1.2.1, above.
- c. Expose the test items to desert conditions while transporting them over the YPG Desert March Trail or its equivalent for a total of 35 miles. Vehicle speed shall be as high as can be obtained without jeopardizing the safety of the crew.
- d. Repeat steps (e) and (f) of 6.2.1.2.1, above.

6.2.1.2.3 Tactical Transportation

a. Load the item under test on to the same type of vehicle organic to and operated by the using organization (see Table V). If items may be transported in the field either with or without their individual containers, both modes shall be used during this phase. Items transported by combat vehicles shall include items in their individual container, and if racks are provided, in racks.

- b. Repeat steps (b) and (c) of 6.2.1.2.1, above.
- c. Expose the test items to desert conditions while being driven over the respective desert types, for the mileages shown in Table VI.

TABLE V. Recommended Vehicles for the Tactical Transportation Subtest

Class of Item and Type	Type of Vehicle		
	Light Tactical (up to 1- $\frac{1}{2}$) ton wheeled or tracked	Heavy Tactical Utility (1) (Includes 2- $\frac{1}{2}$ ton and heavier wheeled & tracked)	Combat Vehicles (Includes tanks, self-propelled guns, armored personnel carrier)
Class II			
Individual Unit	X -	- X	(2) -
Class IV			
All	(3)	X	(2)
Class V (See MTP 4-4-001)			

NOTES: 1. Includes special purpose vehicles such as transporters, tank trucks, vans, articulated cargo carriers, decontamination trucks. Special purpose vehicles should be used only when designed for the commodity type including the test item.

2. This type of carrier should be used if the test item is designed to be used in this environment (cf. collective protective units; protective mask, decontamination units; protective mask, decontamination equipment, etc).
3. If probable transport under combat zone conditions is by this type vehicle, this type should be used in lieu of others.

TABLE VI. Mileage Requirements for Tactical Transportation Subtests

<u>Type Vehicle (1)</u> <u>Type of Desert</u> <u>Components</u>	<u>Light Tactical</u>			<u>Heavy Tactical</u> <u>or Utility</u>			<u>Combat Vehicle</u>		
	<u>Stony</u>	<u>Gravelly</u>	<u>Sandy</u>	<u>Stony</u>	<u>Gravelly</u>	<u>Sandy</u>	<u>Stony</u>	<u>Gravelly</u>	<u>Sandy</u>
Mountains	15	-	5	7	-	3	15	-	5
Badlands/Hills	20	15	5	10	15	4	20	25	5
Fan/Wash	15	15	-	8	15	-	15	25	-
Plains/Flats	20	35	25	10	35	10	20	60	25
Dunes/Fields	-	5	35	-	5	18	-	10	35
Dust	-	5	5	-	5	5	-	10	5
Total	70	75	75	35	75	40	70	130	75

- NOTES: 1. Vehicle types are determined from Table VII.
2. See Appendix B, MTP 10-4-001 for a discussion of desert types and components.

d. Repeat Steps (e) and (f) of 6.2.1.2.1, above for each transportation course of Table VI.

6.2.1.3 Handling Exposure

a. Maintain a critical observation of handling experiences occurring during the various sequences of vehicle loading, unloading, unpacking, storage, and emplacement called for in all of the preceding tests.

b. Evaluate all circumstances in the handling process which, if performed by individuals under combined desert and tactical stress, have a significant possibility of resulting in damage or deterioration. Record all such circumstances by still and motion picture photography.

6.2.1.4 Airdrop Exposure (if applicable)

a. Select test items that have not been subjected to storage exposure tests with the exception of Forward Depot Supply (6.2.1.1).

b. Rig each test item in an airdrop container as indicated in applicable criteria.

- c. Install instrumentation in the airdrop containers and drop zone as outlined in MTP 7-2-509.
- d. Ensure the proper calibration and functioning of all instrumentation.
- e. Conduct airdrops of the test item from appropriate aircraft flying at a speed and altitude prescribed in applicable criteria. A sufficient number of drops shall be conducted to provide a statistically valid basis for determining airdrop suitability of the test item.
- f. Record data in accordance with MTP 7-2-509.

6.2.2 Performance

- a. Remove items which have been left in sealed containers, and identify. Bulk items (e.g., decontaminants, chemical agents, etc.) shall be broken down to the quantities required for individual performance tests, and their containers marked.
- b. Inspect test items for visual signs of deterioration.
- c. Remeasure physical characteristics of selected items to determine changes wrought by exposure.
- d. Assemble items which are components of major items into standard components. Items requiring other operations for use shall be prepared according to operational manuals (e.g., collective protection systems, self-contained breathing apparatus, guided missiles, etc.).
- e. Perform such other preparatory steps as may be specified in the applicable commodity MTP's.
- f. Subject the item under test to performance tests as specified in the applicable commodity Volume 8 MTP contained in Volume I, Index of Commodity Test Procedures.

NOTE: Control items shall be tested intermittently or concurrently with the test items.

g. In addition to the data specified in the referenced or common MTP, record the following information:

- 1) Meteorological data for the days performance tests are conducted
- 2) Terrain conditions of the performance site (including sub-surface logs, if applicable)
- 3) Where applicable, photographs (color, if necessary) showing operational data, such as:
 - a) Smoke or gas generation
 - b) Dust generation

6.2.3 Security From Detection

NOTE: The security from detection subtest may be conducted during the test item's emplacement while undergoing exposure testing as outlined in 6.2.1.

a. Select test sites typical of the worlds deserts and providing suitable background conditions. (See Tables VII and VIII for landscape types and dominant colors in desert terrain).

b. Paint the test items in accordance with colors listed in Table VIII.

- NOTES: 1. The dominant color should be tan, with earth brown used to breakup shapes or patterns.
2. If netting is used for camouflage, garnish should be provided for desert terrain.

TABLE VII. Landscape Types for Desert Testing

Landscape Types

Desert Flats

Hills/Badlands

Fan/Wash Complex

Mountains

Sand fields and dunes

c. With the test item sited or emplaced, replace or remove all displaced natural material and observe and record the camouflage and concealment qualities of the test item as situated in the following terrain types:

- 1) Open desert pavement, no cover
- 2) Rocky or boulder strewn desert, no vegetation
- 3) Terrain having xerophyte vegetation (non-succulent)
- 4) Surfaces composed of loose or drifted sand

TABLE VIII. Dominant Colors in Desert Terrain

<u>Terrain Type</u>	<u>Color</u> <u>U. S. Army Std</u>	<u>Munsell Symbol</u>	<u>ISCC-NBS No.</u> <u>and Abb. Design</u>
Barren areas, bare rock shallow high mountain soils	Earth brown	10 YR, 3/2	81 dgyy Br
Desert alluvial and sedimentary deposits, sand, and thin mountain soils	Tan	7 - 5 YR, 6/6	571. Br
Mountain soils of desert highlands	Earth Red	2 - 5 YR, 4/6	54 br 0

d. Observe and record the extent to which blowing sand and surface finish changes associated with abrasion or solar radiation degrade or improve concealment in the above locations.

e. Observe and record signature effects such as tracks, operational noise, dust clouds, flash smoke, acoustic radiation shadows, etc., during transport, emplacement and actual use of the items under test.

NOTE: Observations concerning camouflage and concealment shall be made with observers positioned at ranges of 500, 1000, and 3000 meters, within line of sight. In cases of test item emplacements greater than 4 sq. yards, observations shall be made from the air.

f. Monitor and record visibility conditions such as the following:

- 1) Atmospheric clarity (freedom from dust and haze)
- 2) Sky conditions (cloud cover)
- 3) Elevation of the sun (time of day and date)

NOTE: Recordings taken during this subtest, shall be made utilizing cover film and high speed motion cameras, if possible.

6.2.4 Maintenance Tests

a. During the cycles of organizational maintenance required in connection with exposure and functioning tests, effects of the desert environment on maintenance conditions and procedures shall be investigated. As test items are removed from storage, or off-loaded from transportation, or assembled and loaded for functioning, observations shall be made of necessary actions to ensure serviceability. Such actions may include cleaning, removal of accumulated dust, tightening connections and fastenings, etc. Maintenance instructions shall be consulted and their adequacy evaluated. Requirements for non-standard tools, equipment and supplies needed to accomplish necessary maintenance, which were not furnished, shall be investigated.

b. Record the following aspects of maintenance:

- 1) Ease of performing required maintenance on test item
- 2) Special tools or skills required
- 3) Interchangeability of components
- 4) Adequacy of instructional manuals
- 5) Photographs shall be taken where necessary

6.2.5 Safety Tests

a. Prior to committing test items to exposure and performance, review applicable safety statement or safety release and examine all test items for conformity and for presence of other hazardous conditions (refer to MTP 8-3-506).

b. In addition to the above, prepare a safety plan to include safety procedures, precautions, protection (including requirements for immunization when biological agents are present), and emergency procedures (including evacuation and medical) as necessary. Other pertinent information such as the technical information or the technical hazards and safety characteristics, analysis of risks, limitations, and precautions including special techniques and test equipment should be included in the safety plan.

c. Ensure that all safety procedures are followed throughout the conduct of the test cycle in accordance with the safety plan, and note the following observations during each of the subtests given in this MTP:

- 1) Clarity of the test item's identification
- 2) Presence of safety warnings
- 3) Adequacy of handling instructions
- 4) Safety of handling procedures
- 5) Presence and adequacy of safety devices
- 6) Sharp or projecting edges, controls, etc.
- 7) Accessibility to emergency cut-off controls
- 8) Replaceable safety devices
- 9) Adequacy of instructions for dealing with emergencies
- 10) Adequacy of personnel operating instructions, (from point of view of safety with respect to heating conditions present during desert testing).
- 11) Interior and exterior temperatures of test items relative to ambient conditions.

NOTE: Observations regarding safety shall be observed and recorded continually during the entire environmental test cycle. Photographs (black and white or color) shall be made of deficiencies whenever possible.

d. Safety deficiencies noted during conduct of safety tests and other tests shall be recorded, and steps taken to eliminate all unsafe conditions whenever possible.

6.3 TEST DATA

6.3.1 Preparation for Test

Data to be recorded prior to testing will include but not be limited to:

a. Leak test data to include:

- 1) Results of leak tests performed before, during, and after environmental testing
- 2) Photographs of items and parts which leaked
- 3) Narrative comments on procedures followed and reasons leakage occurred.

b. Nomenclature, serial number(s)/and or lot number(s), and the manufacturer's name of the test item(s).

c. Results of pretest inspection to include:

1) Shipping container

- a) Physical damage
- b) Any evidence of leaking, spilling, corrosion, or contamination
- c) Adequacy and legibility of markings
- d) Presence and adequacy of unpacking instructions
- e) Presence of packing list
- f) Type and condition of blocking, bracing, and cushioning
- g) Type and condition of intermediate and unit packaging

2) Test Item

- a) Nomenclature, serial and/or lot number(s) of damaged item(s)
- b) Type and extent of damage
- c) Markings used for future identification
- d) Actions taken on damaged item(s)

d. Physical characteristics to include:

- 1) Exterior dimensions on both test item and major components
- 2) Interior dimensions (i.e., volume of containers or munitions, etc.)
- 3) Weight of test item and major components
- 4) Radial and longitudinal center-of-gravity

- 5) Moments-of-inertia
- 6) Any other physical measurements required

6.3.2 Test Conduct

Data to be recorded in addition to specific instructions listed below for each subtest shall include:

- a. Photographs or motion pictures (black and white or color), radiographs, sketches, maps, charts, graphs, or other pictorial or graphic presentation which will support test results or conclusions.
- b. An engineering logbook containing, in chronological order, pertinent remarks and observations which would aid in a subsequent analysis of test data. This information may consist of a description of equipment or components, and functions and deficiencies, as well as theoretical estimations, mathematical calculations, test conditions, intermittent or catastrophic failures, test parameters, etc., that were obtained during the test.
- c. Instrumentation or measurement system mean error stated accuracy.
- d. Test item sample size (number of measurement repetitions).

6.3.2.1 Exposure

6.3.2.1.1 Storage Exposure

a. The following data shall be recorded at hourly intervals throughout storage test periods:

- 1) Ambient air temperature (20 cm above the surface, $\pm 2^{\circ}\text{F}$)
- 2) Ground temperature (5 cm below, $\pm 2^{\circ}\text{F}$)
- 3) Thermocouple readings
- 4) Relative humidity ($\pm 5\%$)

b. The following data will be recorded continuously during exposure of the test item:

- 1) Precipitation (± 0.01 in.)
- 2) Wind speed (20 cm above surface, $\pm 5^{\circ}$)
- 3) Wind direction (20 cm above surface, $\pm 5^{\circ}$)
- 4) Solar radiation (± 10 Btu/ft²/hr)

c. The following data shall be recorded at the conclusion of each storage period:

- 1) All evidences of deterioration, including location on test item, probable effects of deterioration on test item performance, and action taken to alleviate the condition
- 2) All deficiencies attributal to storage exposure

6.3.2.1.2 Transportation Exposure

a. The following data shall be recorded continuously during each road, field, and tactical transportation phase:

- 1) Ambient air temperature (200 cm above surface, $\pm 2^{\circ}\text{F}$)
- 2) Thermocouple readings ($\pm 2^{\circ}\text{F}$)
- 3) Vehicle bed temperature ($\pm 2^{\circ}\text{F}$)
- 4) Vehicle direction ($\pm 10^{\circ}$)
- 5) Accelerometer readings ($\pm 1.0\text{g}$)
- 6) Course description (nomenclature plus topographic details from maps or surveys)
- 7) Time (± 1.0 minute)
- 8) Vehicle speed ($\pm 2\text{mph}$)

b. Record the results of inspection performed after each road, field and tactical transportation phase.

6.3.2.1.3 Handling Exposure

a. Record narrative comments of all circumstances in the handling process which have a significant possibility of resulting in damage or deterioration.

b. Supplement all such above circumstances by still and motion picture photography.

6.3.2.1.4 Airdrop Exposure

a. Record data from airdrop tests in accordance with MTP 7-2-509.

6.3.2.2 Performance

a. Record results of pre-test inspection.

b. Record changes in physical characteristics caused by exposure to desert environmental conditions.

c. Record data during performance tests as indicated in the applicable MTP selected for the test item.

d. Record the following environmental data:

- 1) Meteorological data for the days during which performance tests are conducted
- 2) Terrain conditions of the performance site
- 3) Photographs showing operational data, where applicable

6.3.2.3 Security from Detection

a. Record the observed camouflage and concealment qualities possessed by the test item for each of the following terrain types:

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- 1) Open desert pavement, no cover
- 2) Rocky or boulder strewn desert, no vegetation
- 3) Terrain having xerophyte vegetation (non-succulent)
- 4) Surfaces composed of loose or drifted sand

b. Record the extent to which blowing sand and surface finish changes associated with abrasion or solar radiation degrade or improve concealment.

c. Record signature effects.

d. Record visibility conditions to include:

- 1) Atmospheric clarity
- 2) Sky conditions
- 3) Elevation of the sun

6.3.2.4 Maintenance Tests

a. Record actions taken to ensure serviceability of the test item.

b. Record the following aspects of maintenance:

- 1) Ease of performing required maintenance
- 2) Special tools or skills required
- 3) Interchangeability of components
- 4) Adequacy of instructional manuals
- 5) Photographs as necessary

6.3.2.5 Safety Tests

a. Record data as indicated in MTP 8-3-506

b. Record the following during each of the subtests:

- 1) Clarity of the test items identification
- 2) Presence of safety warnings
- 3) Adequacy of handling instructions
- 4) Safety of handling procedures
- 5) Presence and adequacy of safety devices
- 6) Sharp or projecting edges, controls, etc.
- 7) Accessibility to emergency cut-off controls
- 8) Replaceable safety devices
- 9) Adequacy of instructions for dealing with emergencies
- 10) Adequacy of personnel operating instructions
- 11) Interior and exterior temperatures of test items relative to ambient conditions.

c. Record safety deficiencies noted during tests and steps taken to eliminate all unsafe conditions.

6.4 DATA REDUCTION AND PRESENTATION

6.4.1 Preparation for Tests

- a. Data collected during initial inspection shall be presented in a form which is appropriate relative to the item and test criteria.
- b. The description of the test item, number of items tested, identification number and conditions upon receipt shall be presented in a tabular form.
- c. Results of leak test, shall be presented in a narrative or other convenient form.
- d. Photographs and X-ray pictures shall be used to support all of the above.
- e. Data derived from physical characteristics should be presented in tabular form, supplemented by line drawings and photographs.

6.4.2 Test Conduct

6.4.2.1 Exposure Tests

6.4.2.1.1 Storage Exposure

- a. Graphically summarize data from thermocouples and meteorological instrumentation for the total test period as follows:

- 1) Plot monthly summaries of ambient air temperature and ground temperature, wind velocity, relative humidity, and solar radiation at 6-hour intervals and mark at daily intervals.
- 2) Plot data in (1) above, at hourly intervals for a 24-hour period showing most extreme and mildest days, and a representative day during the exposure period.
- 3) Key the test item thermocouple readings to ambient air temperatures and ground temperature, and plot in the manner of the monthly and daily presentations in (1) and (2), above.

- b. Prepare presentations, as required to illustrate circumstances relating to malfunctions and failures attributed to desert environmental stresses.

- c. Compare values from presentations with prescribed or desired values, tolerances, etc., and determine the acceptability of the test item in this regard.

6.4.2.1.2 Transportation Exposure

- a. Present thermocouple readings and meteorological data as indicated in 6.4.2.1.1 (a), above.
- b. Summarize graphically, acceleration and route data to show:
 - 1) Accelerometer readings, vehicle bed temperature, test item temperature, and air temperature as a function of mileage.

NOTE: Traces shall be annotated to show time of day and start and finish of the various courses.

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- 2) Profiles of routes followed (horizontal scale 1:15, 625 if map plotted; 1:10,000 if surveyed; vertical scale 1:20) including annotations for surface conditions (type and microgeometry), slopes, and other significant data

- c. Prepare presentations, as required to illustrate circumstances relating to malfunctions and failures attributable to desert environmental stresses.

- d. Compare values from presentations with prescribed or desired values, tolerances, etc., and determine the acceptability of the test item in this regard.

6.4.2.1.3 Handling Exposure

Present in narrative form. Utilize still and motion picture frame illustrations, and graphical summaries as applicable.

6.4.2.1.4 Airdrop Exposure

Data derived from airdrop exposure tests shall be reduced and presented in accordance with MTP 7-2-509.

6.4.2.2 Performance

- a. Present data as indicated in the applicable Volume 8 MTP selected for the particular test item.

- b. Same as 6.4.2.1.1.a.

- c. Same as 6.4.2.1.1.b.

- d. Same as 6.4.2.1.1.c.

6.4.2.3 Security From Detection

Present a narrative statement of results of the observations relating to security from detection. Photographic illustrations shall be used as required to substantiate the narrative.

6.4.2.4 Maintenance Tests

Observations will be summarized and presented in narrative form. Where necessary, the narrative shall be supplemented by line drawings and photographs.

6.4.2.5 Safety Tests

Observations and deficiencies shall be presented in narrative form, supplemented as required by line drawings and photographs.

APPENDIX A

CLASSIFICATION OF CHEMICAL, BIOLOGICAL, AND RADIOLOGICAL EQUIPMENT

For environmental testing of CBR materiel, the Army's Classification of classes of supplies based on usage and type has been used as a basis for exposure, transportation and performance tests.

Class II supplies consist of supplies and equipment authorized by Table of Organization and Equipment (TOE), Tables of Allowance (TA) and like which prescribe allowances for a unit or individual. Examples are protective mask, individual decontamination kits, detection kits, etc.

Class IV supplies consist of supplies and equipment issued in addition to prescribed allowances. Examples are bulk chemical agents, breathing apparatus (self contained air/oxygen supply, chemical and biological dissemination devices, etc).

Class V supplies consist of munitions. Examples are smoke grenades, rockets with chemical warheads, chemical land mines, etc.